

November 24, 1893.—Heavy thunderstorm at Hydesville, Humboldt County, the lightning struck a tree about 5 miles east of this town and set it on fire.

December 27, 1893.—Severe thunderstorm passed over Pasadena, Los Angeles County, one bolt of lightning striking a stable and destroying it, along with 75 tons of hay.

July 9, 1894.—At Gardnerville, Alpine County, lightning struck a barn, killing one horse and stunning several persons, and the building was set on fire by the lightning.

In his review for July, 1896, Mr. Barwick says:

There were heavy thunder and lightning storms over all the moun-

tain regions of the State, with numerous cloudbursts, and, singular to relate, these cloudbursts appear to have occurred on the day of the occurrence of the maximum temperature over the greater portion of the interior of the State, namely, on the 9th of July.

Thunder and lightning were reported from several places along the coast, which are rather unusual occurrences. Generally speaking the cloudbursts and thunder and lightning storms occurred during the prevalence of the long and severe hot spell of July, from the 1st to the 25th. From all accounts this was the most disastrous hot spell to the interior valleys of California since the unprecedented hot wave of June and July, 1859, when horses died in great numbers, and even birds and wild animals succumbed to the fierce rays of the sun, and several persons were reported to have died from the effects of the hot wave.

NOTES BY THE EDITOR.

MECHANICAL DETERMINATION OF RESULTANT WIND.

At the December meeting of the Meteorological Society of France, M. L. Besson exhibited an instrument that gives, mechanically, the mean direction and force of the wind, and thus dispenses with the calculations that are necessary in the application of Lambert's method.

This instrument is composed essentially of a vertical wheel, moving easily around its axis, and having near its circumference small equidistant projecting horizontal pins or rods to the number, for example, of sixteen, corresponding to the sixteen principal directions of the wind. If we hang on each of these pins a weight proportional to the movement of the corresponding wind, the wheel will take a certain position of equilibrium, such that the lowest point of the wheel indicates exactly the resultant direction of the wind movement. The apparatus can be made more complete by adding a balanced alidade, which is itself provided at one end with a small pin similar to those of the principal wheel. When the direction of the resultant has been found we set the alidade to the opposite direction, and suspend from it certain weights, until we obtain neutral equilibrium.* By giving to the alidade a convenient length we can thus, directly, measure the relative value of the resultant, that is to say, the degree of variability of the wind during the period under consideration.* The model actually presented to the society shows the simplest form that can be given to this instrument. It is intended for the determination of the mean direction of the wind during any one day, from hourly or tri-hourly observations. The weights that are employed are counters of equal mass, pierced through their centers; each of these represents one observation. One may agree to call the wind variable if twelve counters suspended on the pin opposite to the resultant suffice to bring the system into neutral equilibrium.

These mechanical devices in the hands of skillful manipulators will scarcely do their work more quickly, and will rarely do it as accurately as can be done by the skillful computer. The simple form used by the Weather Bureau for the computation of resultant winds, when used in connection with Crelle's multiplication table, is probably better than the mechanical device, and yet there are many who would prefer the latter as avoiding the ordinary errors of computation.

There are many other mechanical devices that may be advantageously introduced into meteorological computations. Professor Mascart, who presided at the meeting of the Meteorological Society, suggested that the same apparatus could also be applied to the solution of questions regarding the composition of colors, thereby replacing the whirling disk of Sir Isaac Newton, and the color-triangle of Lord Rayleigh. In fact, the apparatus can be used for showing quickly the resultant of any complex system of forces, provided they all act at one point of application and do not introduce moments of rotation.

The apparatus of Besson, as above described, can apparently be simplified by omitting the alidade and substituting

*The variability of the wind is, strictly speaking, shown only by the relative number of the times that each direction of the wind occurs. If the wind has blown from all possible directions, then the resultant velocity is generally much smaller than when the wind blows steadily from one direction, therefore, the strength of the resultant is, in a rough way, indicative of the variability or the degree to which opposing winds have neutralized each other.—C. A.

the following construction. The resultant direction is usually desired to within two or three degrees. In order to secure this degree of accuracy we divide the circumference into 128 equal parts, each representing $2\frac{1}{8}$ degrees, and insert corresponding pins, giving each a letter or number from north around the entire circle consecutively. On a wheel 20 inches in diameter each of the 128 pins would be about half an inch from its neighbor. When the pins for the sixteen wind directions have been properly weighted and the wheel has come to its position of equilibrium, which should be tested by several successive oscillations to the right and left, and when one has decided which of the pins is the lowest when the wheel has come to a rest, and which, therefore, indicates the resultant wind direction, he is to select the pin diametrically opposite to this resultant, and load it with additional weights until the wheel is neutral in all positions. But even in this simplified form it may be doubted whether the mechanism is any better than properly arranged forms of numerical computation.

THE METEOROLOGICAL STATIONS OF HARVARD UNIVERSITY.

The annual report for October, 1896, to September, 1897, inclusive, of Prof. Edward C. Pickering, as director of the astronomical observatory of Harvard College, shows his high appreciation of the importance of meteorology in connection with astronomy. The atmosphere by its refraction alters the apparent position of the stars; by the irregular refractions, due to the want of perfect homogeneity, the atmosphere introduces the blurred images and the rapid oscillations that prevent perfect steadiness of vision and cause the so-called "poor seeing;" by its dispersive power the atmosphere, acting like a prism, gives confusing colors and distorted outlines to the images of the stars and planets; by its general absorption the atmosphere renders the faintest stars invisible, and even the brightest stars may become invisible near the horizon; by its selective absorption the atmosphere introduces its own lines into the spectrum of the sunlight. The search after good seeing and the study of the brightness, or the variations in brightness of the variable stars, have led Professor Pickering to investigate the atmosphere of the Southern Hemisphere, in which work he was encouraged by the late Uriah Boyden, who left a large fund for astronomical research. An astronomical station is maintained at the city of Arequipa, Peru, and in connection with it the following "Boyden" meteorological stations:

Mejia (elevation 55 feet); La Joya (4,141); Arequipa (8,050); Alto de los Huesos (13,400); Mont Blanc station on El Misti (15,700); El Misti (19,200), and Cuzco (11,378).*

*An article by Mr. R. DeC. Ward in Science for January 21, 1898, adds a new station, Echarati, 130 miles north of Cuzco, latitude, $13^{\circ} 31' S.$; longitude, $74^{\circ} 24' W.$; elevation, 11,378 feet. The elevations of the instruments given in the above text have been corrected to agree with this recent article by Mr. Ward, to which we must refer the reader for many interesting details.

Continuous observations were obtained at the summit of El Misti by means of the new meteorograph.

By an arrangement with the Park Commissioners for the city of Boston the upper portion of Blue Hill was purchased in 1875 and transferred to the care of the Harvard observatory. This hill is about eight miles south of the observatory, and upon it was placed one of the transit circle meridian marks when the observatory was first erected by W. C. Bond in 1838. Thus it happens that the Blue Hill Observatory now comes under the general supervision of Professor Pickering and the authorities of Harvard University, but, of course, without interfering with the independence of this coordinated institution. Professor Pickering's annual report states that a description of the method of exploration of the upper air with kites, with a discussion of the observations, from 1894 until the beginning of 1897, forms an appendix to the observations of 1896 in Vol. XLII, Part I of the "Annals," now in course of publication. He also adds that the observations of the New England Weather Service will not hereafter appear in the annals of the observatory, but will be "published in the Monthly Weather Review," by which latter name he, undoubtedly, intends "the Monthly report of the New England Section of the Climate and Crop Service of the Weather Bureau." These monthly reports from the various sections contain a great deal of information that is not given in the MONTHLY WEATHER REVIEW published at Washington, which latter can at best give but a brief summary of the details given in these reports.

IMPORTANCE OF THE MONTHLY REPORTS OF THE SECTIONS.

These monthly section reports are, we fear, not always appreciated as they should be, as a permanent detailed record of our climatic data. The set of twelve numbers for each year should be preserved and bound by each recipient, or if more convenient, presented to some library where it will be properly cared for and generally accessible to the public. If sets of these could be presented to the prominent Government weather bureaus throughout the world, and personally to those who are known to be active students of climatology, they would, undoubtedly, contribute to remove much of the ignorance that prevails with regard to the climate of America.

METEOROLOGY IN THE UNITED STATES GEOLOGICAL SURVEY.

There are, of course, many matters that must be attended to in the prosecution of the duties imposed upon the Director of the Geological Survey that bear closely upon meteorology and the work of the Weather Bureau. There is apparently no duplication of work in these two bureaus, but each must carry on certain parallel lines of work in order to accomplish the object it has in view. On looking over the eighteenth annual report of the director of the survey, for the fiscal year ending June, 1897, we note the following items that will interest the students of American climatology. First of all we must mention the magnificent topographical survey and the published maps without which one can not understand the climatology of any portion of the country, so much does the climate of any spot depend upon its elevation, its aspect, and its drainage. Precise levelings, in the geodetic sense of the word, are made by the Coast and Geodetic Survey, but the detailed plane-table survey belongs to the topographic division of the Geological Survey.

The altitude of the cistern of the barometer is believed to be now known for every Weather Bureau station, by the help of the accurate levels made first for railroad and canal work and now by the Geodetic and the Topographic Surveys. It has sometimes been erroneously assumed by European meteorologists that the altitudes used in reducing American

stations to sea level were necessarily approximate barometric determinations.

Very few have realized the great value of the accurate levelings that have extended over this whole country in connection with the building of railroads and canals. Extensive collections of these levels were first made by Mr. Ellet; these were further supplemented by other data collected by Mr. William Nicholson for the Smithsonian Institution, which were intended as a contribution toward a hypsometric map of North America. Such a map was first prepared by Mr. Schott for the statistical atlas, published in 1874 in connection with the Census of 1870. This data was still further increased by the work done by myself in preparing the revised altitudes of Signal Service stations adopted in November, 1872, which was also the first extensive effort to adjust the discrepancies along the various lines. The work has since then been greatly extended by Mr. Gannett, on behalf of the Hayden Survey and the United States Geological Survey.

The geologist often fills in many details by the help of the barometer, using the differential methods. The method perfected by Gilbert and Gannett for this barometric hypsometry constitutes another point of contact between the work of the Weather Bureau and that of the Geological Survey.

By its study of the glacial drift the Survey contributes to our knowledge of the distribution of ice and snow as the principal climatic feature in one of the ancient eras. In this connection also the study of the water stored up in the soil, as collected from artesian wells, mineral springs, and ordinary wells has not only a direct bearing upon present agricultural possibilities, but upon past climates.

It is found that great agricultural differences arise from varying degrees of porosity of the several classes of glacial and glacial-river deposits. This leads to the conviction that a classification of soils, based upon their relation to the glacial agencies by which they were formed, would be of fundamental importance to agriculture.

Observations have been made by the Survey in a very deep well which is being drilled near Pittsburg and which will probably extend more than a mile into the earth. If such a well can be continued downward far enough to entirely escape the temperature conditions that prevail among the various sedimentary strata near the surface of the globe, it must, eventually, give us much information that will elucidate the evolution of our globe and our atmosphere.

In the division of hydrography, under Mr. F. H. Newell, measurements or computations of the water discharge of the rivers have been made for about 170 rivers, fairly well distributed over the Atlantic and Pacific States and in the interior. In this connection measurements of seepage and measurements of rainfall have, of course, also been made. As the windmill is extensively used in raising water for irrigation, therefore special studies have been made upon the employment and efficiency of windmills. These memoirs, by Barbour, Murphy, and Hood, constitute a first installment of the important work that was commended to the attention of all concerned by the Editor of the MONTHLY WEATHER REVIEW in April, 1895, Vol. XXIII, page 131, in an article on "The Efficiency of Windmills and Farmers' Tools." The measurements of rainfall, evaporation, seepage, and river discharge constitute the fundamental data by means of which we get an approximate idea of the quantity of water that passes back into the atmosphere from the surface of the continent, as distinguished from that which comes from the ocean and from frozen lakes, rivers, and snow beds. These data have also an important bearing on the problems that are involved in every effort to predict the floods and low waters of our rivers, a work that is especially committed to the Weather Bureau.

The most recent addition to the work of the Survey has